Seed Inventory K-2

Overview
NOTE: Seeds are seasonal with few seeds in Winter or early Spring. Please plan accordingly. Students will collect seeds in a given area by putting socks over their shoes, pulling a skunk puppet, or rubbing a small fuzzy towel over grasses and plants to catch the seeds. They will then observe the seeds and look for different shapes and characteristics of the seeds.

Duration
30 min

Grades
K-2

Benchmarks
- Organism
- Heredity
- Diversity/Interdependence
- Collecting & presenting data

Key Concepts
Seeds come in many shapes and sizes. They are protected in a variety of ways so that they can survive and grow. Seeds travel in many ways to new areas.

Objectives
Students will be able to:
- locate and observe many different types of seeds
- categorize seeds by their different attributes
- discuss the importance of size and shape to different types of seeds

Materials
- large wool socks or skunk puppet
- hand lenses
- student handout to record observations
- small baggie for each student
- tape (if wanted for handouts)

Background Information

Seeds are abundant throughout the Refuge and are important to the life cycle of the plants and animals. Students will observe seeds of all shapes and sizes. It is important students disrupt the environment as little as possible as they make their studies.

Suggested Procedure

1. Discuss with your students what seeds are and what they do. Tell them that they are going to collect seeds from a given area and that they are to save the seeds in the baggies. Explain to students that they are to be careful in gathering the seeds and are not to harm the environment around the seeds.
2. Students can work in pairs gathering seeds. They can use large wool socks over their shoes and walk around in a grassy area to gather seeds. Carefully remove any seeds that have gathered on the socks and put the seeds in their baggies. If no socks are available, students can drag a fuzzy towel through the area and carefully remove any seeds that have clung to the towel.
3. Have students walk around the area and gather any seeds that they can find on the ground or within easy reach. Remind students not to harm any plants and to be careful when picking seeds.
4. Have students work with their partners and choose a seed from their baggie to observe. Give students the seed worksheets to complete. Each student will also need a hand lens to get a closer look at the seeds. Students can either tape the seeds on the worksheets or draw the seeds. Go over the words in the word bank to help students describe the seeds.
5. Have them observe 4 different seeds and record their observations. Allow time for the students to share different seeds that they have found and to discuss their observations.

Discussion Questions

1. What are seeds?
2. Where did you find your seeds?
3. Why do plants have seeds?
4. Why do seeds come in so many shapes and sizes?
5. What do seeds do?
6. Why are there so many seeds?
7. Why are some seeds sharp and pointy?

8. Why are some seeds fuzzy or sticky?

9. How do seeds protect themselves?

10. Where else can you find seeds?

11. What do seeds need to start growing?

12. How do seeds travel once they leave a plant?

Assessment Ideas

1. Have students sort their seeds with a partner and arrange the seeds into groups by different attributes. Let them share the groups of seeds and explain how they sorted the seeds.
2. Save the baggies of seeds that students have collected and bring the seeds back to the classroom. Have students collect seeds from home or from around the school and compare the different types of seeds.
3. Discuss with students where else we can find seeds, like in our kitchens, lunches, school grounds, etc.
4. Discuss what types of seeds are safe to eat. Bring various types of seeds in for students to try.
5. Plant some seeds from their collections. Discuss what a seed needs to grow.
6. Have students draw a life cycle of a plant or tree to see what a tiny seed can turn into.

References

Carle, E. *The Tiny Seed.*

Jordan, H.J. *How a Seed Grows*.

Cole, J. & Speirs, J. *The Magic School Bus Plants Seeds – A Book About How Living Things Grow.*

Gibbons, G. *From Seed to Plant*.

Seed Observation

Using a hand lens, take a close look at one of your seeds. Carefully feel the seed. Look at the color and shape of your seed.

Draw a picture of one seed in each of the boxes. Using the word bank below, describe your seed.

Word Bank: seed hard sharp pointy small big round tan brown black green red prickly sticky tiny empty soft furry skinny

Seed Dispersal 6-8

Overview
NOTE: Seeds are seasonal with few seeds in Winter or early Spring. Please plan accordingly. Students will examine plants' seed dispersal strategies in different locations.

Duration
15-20 min

Grades
6-8

Benchmarks
- Diversity/interdependence
- Collecting & presenting data

Key Concepts
Plants have developed many adaptations for spreading their seeds, each suited to that plant's environment.

Objectives
Students will be able to:
- define the term adaptation
- explain different ways seeds can be carried by animals
- identify specific structures/ adaptations of seeds that are beneficial for dispersal

Materials
- binoculars
- pencils
- hand lenses
- plant field guides
- student handout "Seed Dispersal Strategies"

Background Information

An adaptation is defined as a modification of an organism or its parts that helps the plant or animal survive. Plants and animals have to adapt to their environments in many ways. Animals need to have successful strategies to avoid predators, get food and water, reproduce successfully, etc. Plants also need to have strategies for survival, including ways to get sunlight and nutrients from the soil, avoid pests (insects or animals), and reproduce. Since plants cannot get up and move their young to other locations (thus decreasing direct competition for resources to the parent plant), they depend on other methods. Over time plants have developed many unique and interesting ways in which to disperse their seeds.

Method	Example
wind	dandelion floats on an air current; maple seeds twirl in the wind
water	coconuts float
animal consumption	animals eat fruits, and the seeds pass through the digestive tract
animal accident	a burr sticks to the fur of a passing animal
mechanical	pine cones fall and roll away from the tree

Suggested Procedure

1. Review the background information with students. It may be a good idea to review these ideas in a lesson prior to the field trip. Perhaps bring in examples from a home garden, but stress to the students that they will be looking at native plants out in the field.
2. Have students work in pairs to help facilitate the brainstorming process and to reduce time constraints.
3. Ask students to think about the pond location they just came from. What specific plants did they see? How careful an observer were they? They may use examples of seed dispersal from any observations they have made at the site.
4. Some students may want binoculars to scan for plants. Others can use hand lenses to get a more detailed view.

5. Have students fill out the “Seed Dispersal Worksheet.”

Extension/Adaptations

1. Have students identify the plants they observed in the field. Make a chart of those that use each specific strategy. Have them research other native plants that depend on these types of strategies.
2. Have students imagine that one factor (ex: animals) were removed from the ecosystem. How might the seeds of those plants that depend on that factor change over time? What might a seed look like in the future? This will encourage students to hypothesize how the structure of a specific seed may change slightly to allow for a different seed dispersal strategy.
3. Have students conduct an experiment in which they grow seeds in different concentrations. How does overpopulation affect the growth rate of these seeds? How is this related to the need for seed dispersal?

Assessment Ideas

Have students share their finding with pairs or groups. The have students share one seed they found interesting with the class. Collect handouts.

References

Gibbons, G. *From Seed to Plant*.

Carle, E. *The Tiny Seed.*

Gibbons, G. *The Reasons For Seasons.*

Seed Dispersal Worksheet

Plants have developed very clever mechanisms to disperse (spread) their seeds. Look around you for signs of different seed dispersal techniques. If you can, try to get a close look at the structure of the seed. How does the structure fit its function? Find three examples from this site or the site you just came from to complete the chart below. Using the field guides, try to find the name of the plant. If you can't, simply describe some unique characteristics of the plant so you can identify it later.

Plant #1

Sketch of seed:

Important Structures:

Method of dispersal:

Plant #2

Sketch of seed:

Important Structures:

Method of dispersal:

Plant #3

Sketch of seed:

Important Structures:

Method of dispersal:

Why would it be beneficial for a plant to develop strategies to disperse its seeds?

Suppose all the animals were scared away by human intervention. What would happen to the plants that depend on animals to help with seed dispersal? How might this affect this particular ecosystem?

Environmental Contrasts

Overview
The group will view the "U-Pull-It" car-recycling yard next to the refuge and discuss the importance of reducing, reusing, and recycling.

Duration
20-25 minutes

Grades
3-8

Benchmarks
- Understanding the properties and limited availability of the materials which make up the Earth.
- Analyzing & Interpreting Results

Key Concepts
We are all consumers using both non-renewable resources and renewable resources. Everyone must get into responsible habits to care for our planet by saving resources, especially by reducing, reusing, and recycling. Caring for the environment also includes appreciating and taking care of our trees and forests.

Objectives
- Discuss consumption and the problem of waste disposal
- Demonstrate an awareness of conservation and protection of renewable and non-renewable resources.
- Realize the value of recycling

Materials
- "Recycling Discovery Kit" from Refuge or make your own
- student handouts
- clipboards
- pencils

Background information:

The car-recycling yard next to the refuge provides a stark contrast to the beauty of the Refuge. It also provides a perfect teachable moment for reminding students about the importance of reducing, reusing, and recycling.

Vocabulary:

consumption—buying and using goods and services

renewable resource—a natural resource that comes from an endless or repeating source (i.e. the sun, wind, water, fish, trees, cotton, etc.) as long as the source is managed responsibly

non-renewable resource—a natural resource that cannot be re-made or re-grown (i.e., fossil fuels such as coal, petroleum, and natural gas)

reduce—to cut back on or lessen the amount of things we buy or consume

reuse—to find a new function for an item that has outgrown its original use; use again

recycle—using waste as material to manufacture a new product. Recycling involves altering the physical form of an object or material and making a new object from the altered material

Suggested Procedure:

1. Facing east, have the group view U-Pull-It car recycling yard next to the Refuge
2. Ask: "What comes to mind when you look at this car yard after viewing the big wetland, the pond, or the oak savannah behind us?"
3. Discuss the contrast between the two scenes and student feelings that arise as the scenes are viewed. Most students will probably mention how messy or junky the car yard looks.
4. Guide the discussion to what the bigger problem is (disposing of old cars and other waste)
5. What causes this problem? *Consumption*: buying new cars, new bicycles, new clothes and having to throw away the "old" items
6. Connect this problem to the students' own lives: "On a smaller scale, where is this problem in our life?" (Trash disposal at home and at school)
7. Teacher: "How can we help to solve this problem?" (Reduce, Reuse, Recycle)

8. Remind students of the definitions of each, as well as what a renewable and non-renewable resource is.
9. Teacher: "Why is it important to conserve or take care of our resources?"
10. "What could be some good things that are happening at this car yard?
    - They drains all of the fluids from the cars (therefore, there is no leaking of toxic fluids into the Refuge).
    - Numerous car parts are reused and recycled when people need a specific part for their type of car.
11. "How does recycling help places like this wetland?" (Brainstorm ideas)
12. "What are ways that we can use these '3 R's' in our school? At home?"

Have 2-3 "secretaries" for the group write down all the ideas on their worksheet, while students are brainstorming. On the bus, during a rest period, or back in the classroom, the rest of the class can copy down what the "secretaries" have listed.

13. Recycling Discovery Kit: As you take items out of the Discovery Kit, be sure to share the following information with students to reinforce the necessity of recycling. Have them write down on their student handout what the different items become when recycled.
    - Many **old car tires** become new playground surfaces to play on. Did you know? *Old tires are shredded to make new athletic surfaces (for instance the track we run on), playground surfaces, and is mixed with other things to make stronger asphalt to pave our highways.*
    - One **aluminum can** becomes a new soda can. Did you know? *Recycling soda cans kept 1.7 billion pounds of them out of our landfills. Recycling aluminum cans saves 95% of the energy used to make aluminum cans from new ore mined from the Earth.*
    - One piece of **paper** recycled becomes new paper. Did you know? *Paper is the number one material that we throw away. For every 100 pounds of trash that we throw away, 39 pounds is paper. Newspapers take up about 14% of landfill space, and paper in packaging accounts for another 15% - 20%.*
    - A **2-liter pop bottle** becomes clothing that we wear. Did you know? *Here is how many recycled soda bottles it takes to make new items of clothing:*

Belt	*1.5 bottles*
Socks	*1.5 bottles*
T-shirt	*4 bottles*
Sweatshirt	*6 bottles*
Fleece Jacket	*15 bottles*

    - Brainstorm other items that can be recycled **OR** have 3-4 items in the Discovery Kit that small groups can brainstorm unique new ways to reuse them (for example: a metal spoon or lunch milk carton – "What are new ways we can reuse these items?")

This could lead to further discussion back in the classroom about concrete ways the students can make an effort to reduce waste at school and at home. Or this discussion could have already started in a pre-field trip discussion.

References

U.S. Fish & Wildlife Service. *Oregon White Oak: A Landscape Legacy.*

Websites:
California Department of Conservation. *10 Easy Ways to Buy Recycled.*

Can Manufactures Institute. *Fun Facts*

Energy Information Administration. *Energy Kid's Page.*

Ohio Department of Natural Resources. *Recycling Tires.*

Car-recycling yard

Wow! Look at what happens when we recycle...

A plastic bottle becomes a:

Old tires become:

An aluminum soda can becomes a:

Paper becomes:

What are ways we as a class can reduce, reuse, and recycle in our school? In our homes?

1.

2.

3.

4.

5.

Habitat Comparison Walk

Overview
In this activity, students will hike through and compare two different refuge habitats (oak savannah and riparian), looking for plants and animals in each habitat and working on a Habitat Hunt Sheet.

Duration
30 min

Grades
3-6

Benchmarks
- Organisms
- Diversity/Interdependence
- Collecting & Presenting Data
- Analyzing & Interpreting Results

Key Concepts
A habitat provides a home for a plant or animal with suitable food, water, shelter, and space. There are two distinct habitats at this part of the Refuge: the oak savannah and the riparian forest. Each habitat supports plants and animals adapted to living in it. Some animals can live in both habitats.

Objectives
Students will be able to:
- Identify and compare the oak savannah and the riparian habitats on the refuge
- Identify one-three plants or animals unique to each habitat
- Identify which animals / plants could live in both habitats
- Name one reason each habitat is important

Materials
- student handout "Habitat Hunt Sheet"
- clipboard
- pencils
- bird field guide
- plant field guide
- binoculars

Background information:

A **habitat** is a home for a plant or animal. It has four components: *food, water, shelter, and space* suitable to the plant or animal's needs. Each habitat has its own unique characteristics. One the Refuge there are a variety of habitats, each of which supports different plants and animals.

Oak woodlands once covered much of the Willamette Valley foothills. These "savannas" of large, widely scattered oak trees thrived because of frequent, low-intensity fires set by Native Americans. These fires removed competing bush, conifers, and even oak seedlings, allowing a few scattered, older oaks to grow to an impressive size with spreading crowns. Sadly, these savannas and other oak woodlands are disappearing due to a variety of causes. As wildfire has been stopped, closed-canopy oak woodlands and dense Douglas fir or mixed-species forests have replaced the oak savannas. Oak savannas now tend to be small and isolated.

Fortunately, oak savannas can be managed and even restored, to provide a unique ecosystem and wildlife habitat throughout the Valley. In the Willamette Valley over 100 wildlife species use Oregon white oak trees for breeding, feeding, hiding, and resting. For example, woodpeckers, owls, and bats need hollow oak cavities for nests. Squirrels and deer rely on acorns for food. Migrating songbirds hide in leafy oak crowns to rest before continuing their trip.
The spotted gall wasp is an insect that thrives only on Oregon white oak. This gall wasp is a non-stinging insect that lays its eggs on an oak leaf causing the leaf tissue to change and form a protective shell (popper) around the maturing grub

Many of the Willamette Valley's oaks are 300 years old. Occasional giants are over 400 years old. Large oak trees, which could live for hundreds of years, may die within twenty years, if conifers over-top them. Oak seedlings, starting as acorns, can grow six feet tall in just three years and twelve feet tall in five years.

A **riparian zone** is the land and plants that surround the perimeter of a water body. Riparian zones play an important role in fish and wildlife habitat, water quality, and erosion control. They also contain a great diversity of plants and animals because the area provides water, food, and protection. Riparian zones help to keep streams and rivers clean as they filter out sediments and minerals from surface and ground water before they enter a stream or river. Fish depend on the riparian zone for food and protection. Fallen trees and other debris in the water can provide fish with shade and a place to rest and hide. The riparian zone provides the water necessary for many insects reproductive cycle. Riparian areas are also important in helping to regulate water temperature. Many aquatic animals and

insects depend on specific temperatures for survival and reproduction. Birds can find locations for nests, safe roosting spots away from predators, and a place to hunt.

Vocabulary:

riparian area–the strip of land (20 meters or more) that borders each side of a pond, creek, river, or other aquatic area.
oak savanna–a habitat containing widely scattered, older oak trees
biotic–pertaining to life or living organisms in a habitat
abiotic–nonliving elements that impact the growth, composition, and structure of a habitat (e.g., soil, weather, sunlight, oxygen and other gasses, etc.)

Suggested Procedure:

1. Beginning in Station #2 Oak Savanna, ask, "What kind of habitat is this?" (oak savanna)
2. Ask: "What animals have we discovered live in this habitat?" (Use list from previous oak savanna activity or observe for a few minutes and create a list)
3. Discuss the four parts of habitat (food, water, shelter, space) unique to this habitat.

   Where would animals get their *water* here?

   Where would they find *shelter*?

   What *food* would they find in the oak savanna?

   How much *living space* do they have here to share with other animals?
4. Explain what a riparian forest is: "the land and plants that surround the perimeter of a water body." There are two bodies of water for this riparian area: the Tualatin River and Rock Creek.
5. Ask: "What *differences* can you see between the oak savanna and the riparian forest?" (Point to the riparian forest.)
6. Ask: "What *similarities* can you see between the oak savanna and the riparian forest?"
7. As the group walks toward the riparian forest the teacher and other adults point out native plants. Point out the different types of trees they are now seeing, especially in contrast to the oak savanna.
8. Ask: "What are some signs of changing food and water sources?"
9. Ask: "What types of animals and birds could use these plants?"
10. Use binoculars to scan the area for birds and other signs of wildlife. Try to identify as many birds as possible.
11. Each group should take time to stop often, looking for insects, listening for frogs, and observing other signs of wildlife that they can add to their food chains.
12. As the group gets closer to the riparian forest, ask: "What are the four parts of habitat you see here?" (Food, water, shelter, space). Compare these riparian parts of habitat to the oak savanna habitat parts.
13. Teacher: "Both of these habitats are important because they provide food, water, shelter, and space for many different plants and animals here at the Refuge.
14. Point out how fortunate it is that this Refuge has so many different habitat areas. Because of the diversity of habitats, this Refuge is home to a wide variety of plants and animals.
15. Explain the importance of preserving this Refuge, as well as all wild areas.
16. Ask: "What can we do to keep these Refuge habitats healthy?"
    - no litter
    - tell others to care for it
    - try to leave only a small impact on any wilderness area as you enjoy it
    - don't pick flowers, leaves, etc.
    - don't break twigs
    - don't throw rocks
    - don't disturb the soil (as much as possible)
    - be quiet so wildlife is disturbed as little as possible

- don't feed the animals
- don't run
- leave pets at home

17. Student handout Option #1: Have students fill in the handout as they discover differences and similarities between the two ecosystems.
18. Student handout Option #2: Have students draw a picture of the oak savanna and the riparian forest as they observe them side-by-side. Include any signs of wildlife they see or hear in their drawing. Have them give as many details as they can to show the contrast between the two ecosystems.

References

Salt Marsh Curriculum. *Habitat Comparison Walk.*

Habitat Comparison Walk Handout - option #1

Riparian" definition:

Differences between the oak savanna and the riparian area:

1.
2.
3.

Similarities between the oak savanna and the riparian area:

1.
2.
3.

Why is it important to protect riparian areas?

1.
2.
3.

List any producers, consumers, and decomposers from this area:

Habitat Comparison Walk Handout - option #2

Draw a picture of the oak savannah and the Riparian Forest as you observe them side-by-side. Include any wildlife or signs of wildlife you see or hear. Try to give as many details as you can to show the differences between the two habitats.

It's a Small World After All

Overview
NOTE: Ponds are seasonal: dry in the Summer and into early Fall. Call Refuge about status of water level in ponds for Fall field trips. Students will use microscopes to observe tiny aquatic plants and animals.

Duration
30 min

Grades
6-8

Benchmarks
- Diversity/interdependence
- Collecting & presenting data

Key Concepts
Microorganisms play an important role in aquatic ecosystems. Higher organisms are dependent on those below them in the food pyramid.

Objectives
Students will be able to:
- explore a microscopic ecosystem
- differentiate between plants and animals

Materials
- folding table
- microscopes
- eyedroppers
- magnifying insect containers
- small buckets
- large tub
- small plastic trays
- depression slides
- scooping spoon
- journal or white paper
- pencils
- paper towels

Background Information

Note: Due to the delicate nature of the pond study ecosystem, a volunteer naturalist must accompany field trips that utilize this study. During the reservation process, please request a volunteer naturalist to accompany and lead this lesson.

Tiny microscopic plants and animals live in most natural bodies of fresh and salt water. Even though they are small, they are a very important part of the food chain. The following are organisms that students may find in the water on the Refuge:

Phytoplankton (plants)
blue-green algae

Zooplankton or Protist (animals)
These can be classified according to their means of locomotion.
Pseudopods
amoeba

Flagellates
euglena, dinoflagellate, volvox

Ciliates
paramecium, stentor, vorticella, diatom, rotifer

Other organisms
daphnia, cyclops, insect or worm larvae

Vocabulary

protist/protozoan—single-celled (usually) microscopic organisms that are found in water and moist places
pseudopod—a false foot which stretches out of the amoeba's body to help it move and engulf food
ciliates—a group of protists having hairlike structures called "cilia" which surround the cell and are used in locomotion and food gathering
flagellates—a group of protists having one or more whiplike appendages called "flagella" that are used in locomotion

Suggested Procedure

Set up folding table and arrange supplies to be used during the lab. Use large plastic containers to gather water samples. Pour small amounts of water into the round insect viewers. Some of the protists may be large enough to see without a microscope. Have students use eyedroppers to try and catch larger ones or just have them get some water in a dropper.

If using flat slides, remind students that they only need one drop of water.

Since protists move, eat, respirate, excrete waste and reproduce, students may be able to view them carrying on these life processes. Have students make a detailed drawing in their journal of at least one plant and one animal that they find. If students find some interesting specimens, be sure they show their classmates.

When students are finished, pour all water back into the pond/creek. Wipe off slides and equipment before storing.

Assessment Ideas

1. Draw a food pyramid and include protists.
2. Why are plankton and zooplankton so important?
3. Name four animals that rely on protists as a food source.
4. How does pollution in ponds, creeks and streams affect the organisms that live there?

References

Oregon Museum of Science and Industry
Portland, Oregon.

Water Quality Survey

Overview
NOTE: Ponds are seasonal: dry in the Summer and into early Fall. Call Refuge about status of water level in ponds for Fall field trips. Rock Creek has water year round.
Students will test and compare water quality in two different aquatic areas: Refuge pond and Rock Creek.

Duration
20-30 min

Grades
6-8

Benchmarks
- Diversity/interdependence
- Forming a question/ hypothesis
- Collecting & presenting data
- Analyzing & interpreting results

Key Concepts
There are many factors that affect water quality. Water quality can be determined using several chemical and physical tests. Populations of aquatic plants and animals are affected by the quality of water in their habitat.

Objectives
Students will be able to:
- learn proper water quality testing techniques
- determine the water quality by analyzing the results of their water tests
- hypothesize about the reasons for variation in water quality

Materials
- 2 water thermometers (°C)
- meter stick
- 50 m tape measure
- water quality test kit
- small bucket
- student handouts

Background Information

Note: Due to the delicate nature of the wetland ponds and Rock Creek ecosystems, a teacher, chaparone or volunteer naturalist must lead this study. During the reservation process, you can request a volunteer naturalist to accompany and lead this lesson if you are unsure of how to perform the water quality tests.

See Water Characteristics background sheets.

Vocabulary

evergreen—trees that have leaf needles (such a fir and pine) and remain "green" all year long

deciduous—trees that have broad leaves (such as oak or maple) and lose their leaves in the fall

riparian area—the strip of land (20 m or more) that borders a pond, creek, river or other aquatic area

abundant—a large amount

moderate—a medium amount

sparse—a small amount

ppm—parts per million

saturated—a liquid or gas that has so much of an element (like oxygen), that it can't hold any more.

aquatic—water or river

culvert—pipe which stormwater travels through

Suggested Procedure

Tell the students that at this site they are going to be "water quality specialists". Their job is to test the water in the pond and creek. They will keep track of their data on the "Water Quality Survey" sheet. After they have tested the water at both sites, they will share their findings with classmates, analyze the data and make conclusions regarding the water quality at both sites. (Follow up with the "Post Activity—Water Quality Survey Analysis" when you return to school.)

Give each student a "Water Quality Survey" sheet. Fill in the first half of the sheet together as a group. When you get to the "Water Characteristics" section, STOP and divide into teams.

When students are in teams of two, tell them they are now going to specialize in testing different water characteristics. Each team will be doing a different test (dissolved oxygen, pH, phosphates, water color, depth and width, temperature and turbidity). When they are

finished, they will share their data with each other, so be accurate!

Give each pair of students a "Water Characteristics Background" sheet for the water characteristic they will be testing. Allow 5 – 10 minutes reading time. When they are finished with the background information, give them the "Test Kit" and "Procedure" sheet explaining how to do the test.

When teams are sure they understand the procedure, they may begin with the aid of teacher, chaparone or volunteer naturalist.

After students have collected data, you may want to extend this activity by doing Water Quality Survey Analysis, in Post-Field Trip section on page 243.

Student Handouts

1. Water Quality Survey
2. Water Characteristics Background (for the water quality being tested)
3. Percent Saturation Chart

Assessment Ideas

1. Which had the "best" water quality: pond or creek? Why?
2. Name 5 factors that affect water quality.
3. What could be done to improve the water quality of the pond and/or creek?
4. If you made these improvements, what affect would they have on the animals and plants that live there?
5. Draw a picture in your journal of a "perfect" riparian area.
6. How does water quality affect the balance of a population in a pond, creek or river? Give specific examples.

References

Bonneville Power Administration. *Kids in the Creek.*

LaMotte Testing Company.

Watercourse. *Healthy Water, Healthy People.*

Oregon Department of Fish and Wildlife. *The Stream Scene: Watersheds, Wildlife and People.*

Water Quality Survey

River System: *Tualatin* Location: *Tualatin River*

Pond or Creek Name:_____ *National Wildlife Refuge*

Surveyor *(YOU)*_____ Date_____

State: *Oregon* Time of day_____ am _____ pm

Riparian Area (Make a check in the box to rate the amount of each type of vegetation)

Type of vegetation	***Abundant* (+)**	***Moderate***	***Sparse* (-)**
Evergreen trees			
Deciduous trees			
Grass, plants or shrubs			

Percentage of Shaded Water

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Erosion Points

Severe (explain)_____

Moderate (explain)_____

Slight (explain)_____

Instream Debris and Barriers (circle those present)

logs limbs root wads brush dam
culvert leaves falls trash other (specify)

Water Characteristics

Stream Width: _____(meters) Stream Depth: _____(centimeters)

Water Color: clear___ greenish___ yellow/brown___ red___ dark brown___

Temperature: air _____^{o}C surface_____ ^{o}C *creek bottom_____ ^{o}C

Dissolved Oxygen: 0 ppm _____ 4 ppm _____ 8 ppm _____

Dissolved Oxygen Percent Saturation: _____%
(use the *creek bottom temperature and the Percent Saturation Chart to find the %)

Turbidity: 0 JTU (excellent)____ >0 to 40 JTU (good)____
>40 to 100 (fair)____ >100 (poor)____

Phosphate Level: 1 ppm (excellent) 2 ppm (good) 4 ppm (fair)

pH: 3 = really bad 5 = poor 6 = good 7 = excellent 8 = good 9 = poor 11 = really bad

1	2	3	4	5	6	7	8	9	10	11	12	13	14

1 = most acid 7 = neutral 14 = most alkaline

Stream Width and Depth

Water Characteristics Background

Water in some streams moves slowly while in others it moves fast. The surface of some streams is smooth and flat but others may have lots of rapids. The stream may be wide and the bank may be straight, or the stream may be narrow and the bank may curve. These characteristics have an effect on the water quality. Slow moving, shallow water is warmer than fast moving, deep water. Water that moves quickly and has lots of rapids usually contains more dissolved oxygen. Different plants and animals prefer different types of streams.

Factors that affect Stream Width and Depth

The path that a stream follows and its width and depth can change over time and during different seasons of the year. The amount of water that travels downstream in a stream depends on the headwaters, or source, of the water. Does the water come from snowmelt, an underground spring, another creek or rainwater? The farther away a pond or stream is from the source of the water, the more the depth and width will change throughout the year. Streams that get most of their water from rainfall are more shallow and narrow in drier months of the year. A pond that gets its water from an underground spring will usually remain the same width and depth all year long. The volume, or amount, of water that moves in a stream also determines its width and depth.

Vocabulary

dissolved oxygen—oxygen that can be found in water

headwaters—the beginning or source of a stream, river or pond

Materials

tape measure

meter stick

Water Color

Water Characteristics Background

The color of pond or river water can help you find the "productivity" of the water. The number of plants and animals that are living in a body of water at any given time is called "productivity." Water that has low productivity has few living things and is poor water (scientifically speaking), but it is considered "clean" and good for a water supply or recreation. Water that has high productivity has many living things and can be both good and bad depending on if you're a human or a fish. Humans consider water with a strong odor or filled with weeds and algae to be a problem. However, fish such as catfish, bass or sunfish would like this type of water because of all the food that would be available to them.

Factors that affect Water Color

The color of water in a pond, creek or river is affected by both living and non-living things. Living things include both plants and animals such as algae and microorganisms. Non-living minerals such as sulfur, iron and calcium also affect water color.

Vocabulary

productivity—the number of plants and animals that are living in a body of water at any given time

algae—tiny plants that live in water

microorganisms—tiny animals that sometimes live in water

sulfur, iron and calcium—minerals sometimes found in rocks

Materials

small test tubes

Dissolved Oxygen

Water Characteristics Background

Aquatic animals need "dissolved oxygen" to live. Fish, invertebrates, plants and some kinds of bacteria require oxygen for respiration. Oxygen in the air dissolves easily into water until the water is saturated. Once the oxygen is dissolved in water, it is released very slowly and depends on the movement of the water. Oxygen is also produced by plants and algae living in the water.

The amount of oxygen needed for different plants and animals varies according to the species and stage of life. Dissolved oxygen levels below 2 or 1 ppm (parts per million) will not allow fish to live. Dissolved oxygen levels below 3 ppm are very stressful to most aquatic organisms. Levels of 5 – 6 ppm are usually required for most organisms to live.

Dissolved Oxygen Percent Saturation is an important measurement of water quality. Cold water can hold more dissolved oxygen than warm water. For example, water at 28° C will be 100% saturated with 8 ppm dissolved oxygen. However, water at 8°C can hold up to 12 ppm of oxygen before it is 100% saturated. High levels of bacteria from sewage or rotting plants can cause the percent saturation to decrease.

Factors that Affect Dissolved Oxygen Concentration

Since temperature directly affects the amount of oxygen in water (the warmer the water the lower the amount of oxygen), then all factors that affect water temperature affect dissolved oxygen. Industrial factories and power plants sometimes release warm water into rivers. Organic material from dead plants and animals, animal and pet waste, woody debris and leaves, fertilizers, urban stormwater runoff, agricultural runoff, and wastewater treatment discharge all decrease the amount of dissolved oxygen in water.

Vocabulary

dissolved oxygen—oxygen that can be found in water

respiration—to exchange gases such as oxygen and carbon dioxide; to breathe

saturated—a liquid or gas that has so much of an element (like oxygen) that it can't hold any more

invertebrate—small animal without a backbone like a clam, snail or crayfish

aquatic—something that lives in water

organism—an animal

stormwater—rainwater that falls on streets, and roofs that ends up in streams and rivers

Materials

Test Kit for dissolved oxygen

percent saturation chart

bucket for wastewater

Dissolved Oxygen
Percent (%) Saturation
high % saturation = more oxygen = better water quality

Temperature (°C)	0 ppm	4 ppm	8 ppm
2	0	29	58
4	0	31	61
6	0	32	64
8	0	34	68
10	0	35	71
12	0	37	74
14	0	39	78
16	0	41	81
18	0	42	84
20	0	44	88
22	0	46	92
24	0	48	95
26	0	49	99
28	0	51	102
30	0	53	106

Example: If the water sample temperature is 16 °C and the Dissolved Oxygen test result is 4 ppm, then the water is 41% saturated with dissolved oxygen. This means that less than half of the water has oxygen in it, which is poor water quality.

Dissolved Oxygen (% Saturation)	Test Results
91-110	excellent
71-90	good
51-70	fair
less than 50	poor

Temperature

Water Characteristics Background

The temperature of the water in a creek or pond is very important for the plants and animals that live there. Many kinds of fish and aquatic life cannot live in warm water and will die or migrate if the water gets too warm or cold. Warmer water makes it harder for many aquatic organisms to fight off disease caused by pollutants and parasites.

Water temperature also affects the amount of dissolved oxygen water can hold. The warmer the water, the less oxygen it can hold. The less oxygen, the less living things there will be.

Factors that affect Water Temperature

Removing trees and plants next to streams or lakes takes away shade. Shade does not cool water, but keeps it from heating as quickly. Fast moving water is cooler than slow moving water. Water that is slowed down to use for dams and irrigation heats up more quickly. Heated water from factories and power plants can cause water temperature changes that upset the balance of entire ecosystems.

The amount of water in a pond or creek also influences its temperature. Shallow water warms faster than deep water. The deeper the water, the cooler its temperature. When water is dammed it creates a pond, reservoir, or wide area with a larger surface area. When this large area of water is exposed to the sun, it absorbs more energy and the water temperature rises.

Vocabulary

migrate—move to a different place

aquatic—something that lives in water

pollutants—something that causes pollution in water such as sewers, chemicals, trash and animal waste

parasites—tiny living things that can cause diseases or kill other animals

dissolved oxygen—oxygen that can be found in water

irrigation—water used on crops such as corn and wheat

ecosystem—all living and non-living things in an area such as fish, plants, rocks, water and insects

reservoir—water storage area

surface area—the top of the water

Materials

2 thermometers (^{o}C)

pH

Water Characteristics Background

The pH test is one of the most common types of water tests. People test the pH in swimming pools, hot tubs, drinking water and creeks. pH is a measurement of the activity of hydrogen ions in a water sample. The pH scale ranges from 0 – 14. Water samples with a pH below 7.0 are said to be "acidic." Water pH above 7.0 is "basic" or "alkaline." Water with a 7.0 pH is considered "neutral."

A pH range of 6.5 to 8.2 is the best for most organisms. Most creeks and ponds have pH levels from 5.0 to 8.5. Acidic, freshly fallen rainwater may have a pH of 5.5 to 6.0. Alkaline soils and minerals can raise the pH to 8.0 to 8.5. Salty ocean water usually has a pH value close to 8.0.

pH Scale

1 = most acidic 7 = neutral 14 = most alkaline

3 = really bad 5 = poor 6 = good 7 = excellent 8 = good 9 = poor 11 = really bad

1	2	3	4	5	6	7	8	9	10	11	12	13	14

Factors that affect pH Level

Air pollution from car exhaust and burning fossil fuels increases the amount of sulfur and nitrogen oxides in the air. Then when it rains, these chemicals combine with the water in the air and turn it into "acid rain." This rain increases the acid level, which lowers the pH, of lakes and streams.

Fast growing algae and plants remove carbon dioxide (CO_2) from the water during photosynthesis. This can result in a large increase in pH.

Runoff that contains wastewater from neighborhood lawns and streets, farms and factories sends pollutants to creeks and ponds, which raise or lower pH levels.

Vocabulary

acidic—containing acid (examples: lemon juice, vinegar)

basic or alkaline—the opposite of an acid (examples: soap, bleach)

neutral—not acidic and not basic; right in the middle (examples: clean water)

runoff—rain water that moves across land and picks up pollutants

pollutants—something that causes pollution in water such as chemicals, trash, and animal waste

algae—tiny plants that live in water

photosynthesis—the process in which plants make their own food by using the sun's light

minerals—elements found in rocks

fossil fuel—petroleum products such as oil and gasoline

sulfur and nitrogen oxides—chemicals

Materials

Test Kit for pH

bucket for waste water

Turbidity

Water Characteristics Background

Turbidity is the measurement of how "clear" water is. Turbid water is caused by sediments such as clay, silt and microscopic plants and animals. Sediments can carry nutrients and pesticides which lower the water quality. Sediments can settle to the bottom of streams, smothering aquatic life and fish spawning areas. Tiny particles of clay can remain floating in water for many, many years before finally settling on the bottom of a river.

Turbidity should not be confused with color, since dark colored water can still be clear and not turbid. Turbid water may be the result of soil erosion, urban run-off, algal blooms and bottom sediment disturbances, which can be caused by boat traffic and abundant bottom feeders.

Factors that affect Turbidity

When trees and plants are removed from riparian areas, soil erodes and falls into the water making it turbid. Cattle and other animals that are allowed graze and drink near streams break down the edge of the riverbank, allowing soil to fall into the water too. Runoff from neighborhood lawns and streets, farms, logging, mining and building areas sends sediments into creeks and ponds, making the water more turbid.

Vocabulary

turbidity—how "clear" the water looks

turbid—water that looks "cloudy"

sediments—tiny pieces of soil, clay or sand

nutrients—food

pesticides—chemicals which kill animals

aquatic life—plants and animals that live in water

spawning—places on the bottom of a stream or river where fish lay their eggs

riparian area—the strip of land (20 m or more) that borders a pond, creek or river

erode—to break down

runoff—rain water that moves across land and picks up sediments

Materials

Test Kit for Turbidity

Phosphates

Water Characteristics Background

Phosphates are found in a mineral called "apatite" which occurs naturally in some rocks. Rocks with a lot of apatite are called "phosphate rocks." The natural weathering and erosion of these rocks makes tiny particles of phosphates that can easily be carried by water to ponds and creeks.

Phosphorus can be found in ponds and creeks in the form of phosphate (PO_4). Phosphorus is a nutrient that acts like a fertilizer for aquatic plants. When plants and algae get a lot of nutrients, they grow very fast and spread out creating water quality problems. The fast growing plants prevent the sun's light from passing through the water, which eventually kills other plants living deeper in the water. When large amounts of plants begin to die and decay, bacteria eat the plants, grow and multiply which uses up the dissolved oxygen in the water.

Factors that affect Phosphates

More than half of the phosphates found in lakes, streams and rivers are the caused by human activity. Animal and human waste, fertilizers from farms and lawns, logging and mining activities all increase the phosphate level in creeks and ponds. More than half of the phosphate in ponds, streams and rivers is from soap and detergent.

Vocabulary

phosphates or phosphorus—chemicals found in lawn fertilizer and some rocks

weathering and erosion—wearing away or breaking down into smaller pieces

nutrient—food

fertilizer—chemical that gives nutrients to plants

aquatic—something that lives in water

algae—tiny plants that grow in water

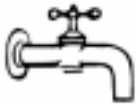
dissolved oxygen—oxygen that can be found in water

Materials

Test Kit for Phosphates

bucket for waste water

Fact Sheet



Relationship of Water Color to Productivity

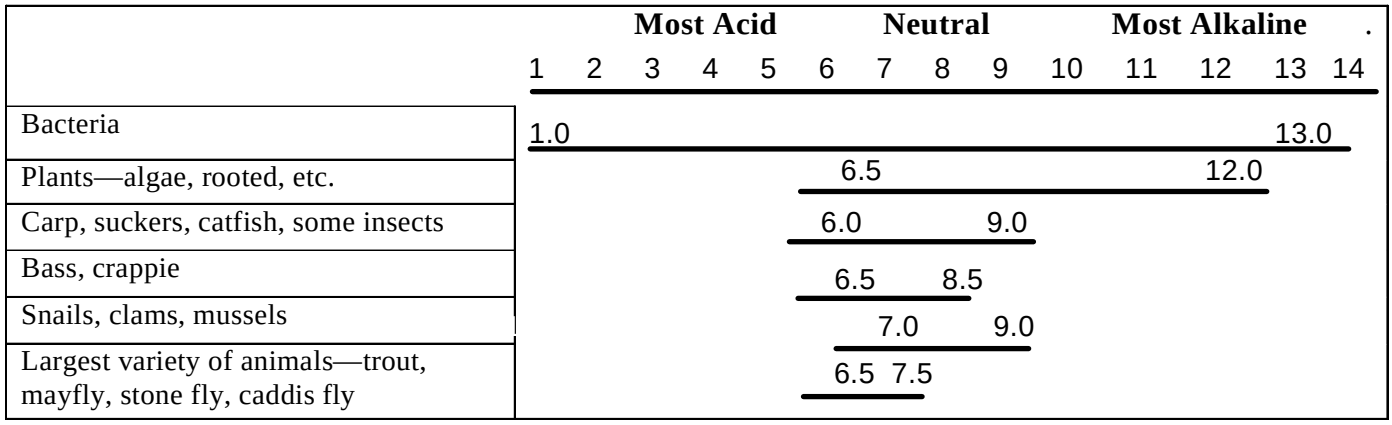
The quantity of life that may be present in a body of water and be available for other organisms to eat is often referred to as the "productivity" of the water.

Color of Water		Most Likely Cause	Fish Food Productivity
Clear		Absence of algae and microorganisms	Low
Greenish hue		Blue-green algae	Moderate
Yellow to Yellow-brown		Diatoms—microscopic, one-celled algae	Moderately High
Red		Micro-crustaceans	High
Dark brown		Peat, Humus	Low
Geological Factors that Affect Color			
In limestone geology	Green	Abundant calcium	Moderate
In volcanic geology	Yellow-green Red	Abundant sulfur Abundant iron	Low Moderate

Temperature Ranges (Approximate) Required for Organisms

Temperature	Examples of Life
High Range—warm water Greater than 68°F or 20°C	Much plant life, many fish diseases. Mostly bass, crappie, bluegill, carp, catfish, caddis fly
Middle Range 55°F - 68°F 14°C - 20°C	Some plant life, some fish disease. Salmon, trout, stone fly, mayfly, caddis fly, water beetles
Low Range—cold water Less than 55°F or 14°C	Trout, caddis fly, stone fly, mayfly

pH Ranges That Support Aquatic Life



Riparian Forest

Overview
Students will walk around a riparian area looking for signs of wildlife activity and discuss the importance of maintaining the riparian area, as well as come up with preservation ideas.

Duration
20-30 min

Grades
K-2

Benchmarks
- Organism
- Heredity
- Diversity/Interdependence
- Forming a question/ hypothesis
- Science & social perspective

Key Concepts
Riparian areas are rich in plants and animals, and must be protected to maintain a healthy ecosystem.

Objectives
Students will be able to:
- identify and discuss characteristics of a riparian area
- discuss the importance of riparian areas to both humans and wildlife, and the need to maintain these areas for future use
- make observations of wildlife and record it in their journal

Materials
- journals or student handout "Riparian Area"
- pencils

Background Information

A riparian zone is an important natural area next to a waterway such as a river, stream, lake or pond. Riparian areas are important for animal and plant life, providing food, shelter and space in which to live and grow. In a riparian area, you will observe many different types of plant and animal life. Students may observe a range of animal life from tiny insects to large deer. There is a variety of plant life from grassy banks of a river to large trees and bushes nearby. Riparian areas are filled with plant and animal life, so students will have to make careful observations in the water, on the banks of the river or creek, in bushes, in tree tops, etc.

Riparian areas are also important recreational areas for people. These areas are often used for fishing, boating, camping and picnicking. Many laws are in place to protect riparian areas to preserve them for wildlife as well as future recreational use. Students need to be reminded to leave any natural area the way that they found it.

Suggested Procedure

1. Walk students around Station #5, riparian forest. Discuss with students what a riparian area is and how important this area is to humans and wildlife. Have students stop and make quiet observations of any plant or animal life around them. Remind students to look all around in the water, along the banks of the water, in bushes and trees and even in the tree tops. Have students stop and listen for signs of life around them. Have students smell the air to see if they can find any differences between this and other areas they have visited. Remind students to stay on pathways to protect the plant and animal life and that they are not to go in the water.
2. Discuss with students their observations. Be sure to include what they saw, heard, or were able to smell. Ask students why this area looks, sounds or smells different from a city street or open field. Tell students that the banks of a riparian area store water and that in a riparian area you will find much more vegetation than in other areas. The heavy vegetation provides food and shelter for many animals, so in this type of area you will also find an abundance of wildlife.
3. Have students draw their observations in their journals or on the worksheet "Riparian Area". Allow time for sharing of their pictures.
4. Discuss with students what they think people could use this area for. Discuss the many recreational uses like boating, fishing, picnicking and just enjoyment of the beauty.

5. Have students draw in their journals or on the worksheets ways that people can use riparian areas.
6. Have students share their drawings of human use of riparian areas and discuss ways that we can use these areas without destroying the plant and animal life. Let students come up with ideas on how to preserve these areas. Remind students that there are laws that help preserve areas for wildlife and that we must be careful that we leave natural areas the way that we found them.

Discussion Questions

1. What is a riparian area?
2. Why are riparian areas important to people and wildlife?
3. What are some animals you might find in a riparian area?
4. What are some plants and trees you might find in a riparian area?
5. What uses do people have for riparian areas?
6. What can people do to preserve riparian areas?

Assessment Ideas

1. Have students come up with a plan to develop a park in a riparian area. Have them plan what would be needed to make it a fun area for people while keeping the area nice for the wildlife.
2. Have students do a Venn diagram comparing a riparian area to a city street or their school yard.
3. Have students pick out a favorite animal that may live in a riparian area. Have students write a story about what that animal might do for one day in its life.

Place students in groups to discuss different plant and animal life that they observed while visiting the riparian area. Have students each do a part of a watercolor mural that shares the importance of a riparian area for plant and animal life.

References

Project Wild Aquatic Education Activity Guide

Animals and Habitats - On land, ponds, rivers and oceans Draw, Write, Now; Maurie Hablitzel & Kim Stitzel

Riparian Area

Draw what you can see, hear, or smell around you in the riparian area. Look up, down, and all around! Stop and listen quietly for a few moments.

How can people use the riparian area?

Riparian Zone Inventory

Overview
Students will make observations and take data on the vitality and health of the riparian zone.

Duration
15-20 min

Grades
6-8

Benchmarks
- Diversity/interdependence
- Collecting & presenting data

Key Concepts
Riparian zones provide animals with a place to find shelter, food, and water, and are thus a critical component of a healthy ecosystem.

Objectives
Students will be able to:
- collect data pertaining to the characteristics of the riparian zone
- analyze their data to make a determination of the overall health of the riparian zone

Materials
- data collection sheet
- pencils
- meter stick
- thermometer
- water quality test kit

Background Information

A riparian zone is the land and plants that surround the perimeter of a water body. Riparian zones play an important role in fish and wildlife habitat, water quality, and erosion control. They also contain a great diversity of plants and animals because the area provides water, food, and protection. Riparian zones help to keep streams and rivers clean, as they filter out sediments and minerals from surface and ground water before these pollutants enter a stream or river. Fish depend on the riparian zone for food and protection. Fallen trees and other debris in the water can provide fish with shade and a place to rest and hide. The riparian zone provides the water necessary for many insects' reproductive cycles. Riparian areas are also important in helping to regulate water temperature. Many aquatic animals and insects depend on specific temperatures for survival and reproduction. Birds can find locations for nests, safe roosting spots away from predators, and places to hunt.

There are specific characteristics of healthy and unhealthy riparian zones:

Characteristics of an Unhealthy Riparian Zone
Low water levels
Low water quality
Little shade
Poor fish habitat (lack of fallen trees and pools)
Low wildlife diversity
Low level of plants with root systems to help stabilize stream banks

Characteristics of a Healthy Riparian Zone
High water levels
High water quality
Adequate shade
High wildlife diversity
High level of plants with root systems to help stabilize stream banks

Suggested Procedure

1. Walk students carefully down through a riparian zone until they reach the stream.
2. Remind them as they collect their data that they are in other animals' homes and need to be careful about noise level and where they are walking.
3. Fill out a data collection sheet. They will need to collect specific water/habitat quality values to evaluate health of riparian zone.

Extension/Adaptations

1. Have students compare this riparian zone to another one, looking at specific riparian zone characteristics and diversity of plant and animal life.
2. Have students write a letter to _____ (i.e., congressional leader, refuge manager, city counsel member) with suggestions on how they can improve the site.
3. On a scale of 1-10 (1 being very bad and 10 being great), how would you rate the health of this site? Be sure to back up your answer with specific reasoning.

Assessment Ideas

Have students share their finding with pairs or groups. Then have students share one area of the riparian zones they found interesting with the class. Collect handouts.

References

Norris, J. *Pond and Stream Habitats, A Complete Thematic Unit.*

Gibbons, G. *The Reasons For Seasons.*

Seifert, P., & Doherty, P. *Exploring Tree Habitats*.

My Special Tree

Overview
In this activity students will choose one tree to observe. Students will gain an awareness of the parts of a tree and how animals and insects depend on trees for survival.

Duration
30-45 min

Grades
K-2

Benchmarks
- Heredity
- Diversity/Interdependence
- Collecting & presenting data

Key Concepts
Trees are found in many different habitats. To be healthy, trees need food, water, and clean air just like humans. Trees provide habitats for many different animals, plants, and insects.

Objectives
Students will be able to:
- identify the parts of a tree, including: roots, trunk, bark, branches, crown, and leaves
- observe a tree and take inventory of any animals, plants, or insects in and around the tree

Materials
- crayons
- pencils
- journal paper
- hand lenses

Background Information

Trees are an important part of our environment. They provide habitats for plants and animals as well as many benefits for humans.

Suggested Procedure

Have students choose a tree to observe or share one tree as a group. Review the worksheet pages with the students and talk about how to make observations. Remind students to use their five senses. Using their eyes to observe, walk around the tree and look up, down and around the tree for any signs of activity from insects or animals. Use the magnifying glasses and binoculars for a closer look. Using their sense of hearing have students stand still for a few minutes and listen for sounds in and around the tree. Try to identify what is making the sounds. Using touch, have the students feel the bark of the tree and any leaves or branches that they can reach.

Have the students smell the tree and the area around the tree. Remind the students to never use their sense of taste on unfamiliar things in nature.

Have students complete the first worksheet called “My Tree”. Encourage students to include their observations in the drawing of their trees. If a leaf from their tree is too large to fit in the box on the worksheet, have students draw a picture of their leaf instead.

Discussion Questions

When students are finished with their drawings and rubbings, have them share what they observed about their tree.

Discuss the following questions:

1. What did you find around the tree on the ground?
2. What did you notice about the trees trunk?
3. Did you see anything on the trunk of the tree”
4. What did you notice in the trees branches?
5. Did you see any signs of life in or around the tree? Remind students this can include holes in the bark or leaves, footprints, nests, etc.
6. What color and shape are the leaves?
7. What do you think will happen to the leaves through the seasons?
8. Would this tree be a good home for any animals or insects? Remind students that a habitat is an area that provides everything a plant or animal needs to survive. A tree may be an entire habitat for an animal or it may provide just food and shelter.

Have students complete the next worksheet called “All About My Tree”. Remind students to use words from the word box to help them. Have students share their descriptions of their trees. Discuss why the tree may be a good habitat for some animals and not for others.

Assessment Ideas

1. Walk around school grounds and have students find a tree to do a similar observation on. Have students compare the original tree at the wetlands and a second one on the school grounds. How are they alike or different?
2. Have students make up a story of an animal living in the tree they observed.
3. Provide tree identification books for students and have them try to identify the type of tree they observed. Remind students to use the shape of the leaves as a guide when looking up their tree.
4. Have students do a watercolor painting of the tree they observed including the area around where the tree was found.

References

Copycat Magazine, Sept./Oct. 2003

Mailbox Magazine, Aug./Sept 2002

Project Learning Tree Environmental Education Activity Guide

Mellett, P. *Trees (Fantastic Facts).*

Seifert, P. & Doherty, P. *Exploring Tree Habitats*.

My Tree

Here is a picture of my tree. It has a trunk, branches, and leaves.

Here is a rubbing of my tree's bark. The bark protects my tree from animals, bugs, and weather.

Here is a rubbing of a leaf from my tree. Every tree has a special shape of leaf. Leaves make food for the tree.

All About My Tree

Word Box: tree tall short brown green rough smooth grassfield bushes bark leaf branch crown moss bird squirrel nest roots seeds insects ants

Where did you find your tree?

_____

_____

Describe what your tree looks like.

_____

_____

How does the bark feel?

_____

_____

Every kind of tree has its own special leaf. The leaves make food for the tree to grow. Tell what your leaf looks like.

_____

_____

Look for signs of animals or bugs that might live in your tree. Can you find tracks, chew marks, or nests? What might live in your tree?

_____

_____

Tree Cookies

Overview
Students will learn about trees by looking at the growth rings on a tree cookie. By observing the rings, students can see how the tree's environment affects the tree's growth over the years.

Duration
20-30 min

Grades
K-2

Benchmarks
- Organism
- Heredity
- Diversity/Interdependence
- Collecting & presenting data
- Analyzing & interpreting results

Key Concepts
The growth rings of a tree tell a story about the tree: age, weather, fires, disease, and floods. Scientists can tell a lot about both the tree and the environment by studying the growth rings.

Objectives
Students will be able to:
- identify a tree's growth rings
- infer from a tree's growth rings what might have occurred during a tree's life
- draw the annual growth rings of a pretend tree and be able to tell a story about their tree

Materials
- tree cookies
- hand lenses
- student handout "story of a Tree"
- pencils

Background Information

You can tell the age of a tree by counting its growth rings. The rings tell a story about what has happened to the tree over the years, including weather, fires, disease, and floods. The growth rings may be far apart or close together depending on the growing conditions for that year. If a tree's growth rings are close together, that can mean a poor growing year for the tree because of many factors like drought, disease, or some sort of growing stress. A good growing year will be shown by a wider growth ring.

Suggested Procedure

1. Take students to an area where there are a few trees in various shapes and sizes. Ask students to estimate how old those trees are. Explain that they are going to be looking at a tree "cookie," which is a cross-sectional slice of a tree trunk. On the tree cookie they will see circles or "rings" that help tell how old a tree is.
2. Show the students the tree cookie and have students estimate how old the tree was before it was cut down.
3. Pass the tree cookie around, having students count the rings. Discuss how old the tree was and why that tree may have been cut down.
4. Have students look at the rings with hand lenses and discuss why some rings are close together and some are far apart. See if students notice any holes in the sapwood. Sap and water travel through these holes up the trunk and into the branches of the tree. The holes should be visible with the hand lenses.
5. Explain to students how there are many things that affect the growth of a tree. When it is a harder year for a tree to grow because of less water, severe weather or disease, the rings are closer together. When it is a good growing year because of good weather and lots of water, the rings will be farther apart. Let students come up with reasons that may affect a tree's growth and discuss these.
6. Give each student the handout called "The Story of a Tree". Give time for students to fill in the annual rings of a pretend tree and remind them to think about good growing years and slow growing years for their tree. Remind students to be able to tell the reason that the rings are far apart or close together. Have them put the age of their tree at the bottom of the page.
7. Have students meet in small groups or with partners and tell each other the story of their tree from their tree cookie.

Assessment Ideas

1. Give each student a paper plate and tell them it is a tree cookie for them to create and tell the story about. The bumpy outside ring of the paper plate is the bark. Remind students to show years of rapid or slow growth for their tree. Have students write a story about their tree and why it grew fast or slow some years.
2. Cut a large onion in half to use as a tree "cookie". Have students make prints from the onion, dipping the onion in paint and pressing it on paper. The onion print should look like a tree cookie. Have students tell about their tree and count the rings to tell how old the tree is.
3. Have students create a tree cookie on a paper plate that is the same age as they are. Instead of telling about a tree, have the students tell about themselves for each annual ring. For example, the first ring could be when they walked, three could be the start of preschool, the fifth ring could be the start of kindergarten, etc.
4. Ask students what we can learn about a tree from the growth rings. Check their worksheets for accuracy in the drawings and in the numbers of years that they say their tree has been alive. Older students can write their tree's story on the back of their paper.

References

Gibbons, G. *Tell Me, Tree – All About Trees For Kids.*

Lauber, P. *Be a Friend to Trees*.

Balla, C.R. *A Tree is a Plant*.

Mellett, P. *Trees (Fantastic Facts).*

Project Learning Tree Environmental Education Activity Guide

Stump Hunt

Overview
By careful observation of a tree stump or "beaver cookie," one can learn a wealth of information about the past life of the tree.

Duration
20-30 min

Grades
6-8

Benchmarks
- Forming a question/ hypothesis
- Diversity/interdependence
- Collecting & presenting data

Key Concepts
Many factors influence the growth rate of a tree - sunlight, space, nutrients, and water; fire, disease, animals, weather, and wind.

Objectives
Students will be able to:
- learn about the anatomy of a tree
- hypothesize about past events in the life of a tree
- compare and contrast different tree stumps

Materials
- clipboards
- pencils
- hand lenses
- beaver cookies (tree slices)
- student handouts "Parts of a Tree", "Cross Section of a Tree," "Reading the Rings", and "Stump Hunt"

Background Information

See "Parts of a Tree" information sheet on page 237.

Suggested Procedure

Pass out "Parts of a Tree" and "Cross Section of a Tree." In a large group, read "Parts of a Tree" aloud and have students refer to "Cross Section of a Tree" to identify the different parts.

Tell students that they can learn a lot about the life of a tree by looking at its rings. Have them look at the "Reading the Rings" sheet and predict what happened to trees A, B, C, and D. Choose one or more of the problem factors in the right column, and match them to the tree in the left column. Hint: There may be more than one correct answer.

Answers for "Reading the Rings"

A. Cross Section: The uneven growth rings could have been caused by a fallen tree leaning against the tree (picture 1). The tree grew more on one side than the other and curved up around the fallen tree. Also, this uneven ring pattern could belong to a tree growing on a steep slope (picture 6).

B. Cross Section: The scar in this cross section was caused by a forest fire during the tree's sixth growing season (picture 2).

C. Cross Section: The mark beginning in year six is all that's left from a branch that either died, or was cut or broken, and fell off (picture 7). Eventually the tree's trunk grew around the remains of the branch and covered it.

D. Cross Section: Most of the growth rings are widely spaced, which would indicate that this is normally a fast growing tree. The narrow rings could have been caused by several factors. If a tree lost all or most of its leaves because of an insect attack (picture 4) or drought (picture 3), it would not be able to make food and would grow very little that year. Root damage from construction of a house or sidewalk too close to the tree would reduce the water and nutrients the roots could absorb (picture 5).

Ask students if they can think of other factors that might cause narrow growth rings (disease, cold winter, late spring frost, transplanting, competition from other trees for sunlight and nutrients, etc.).

Pass out "Stump Hunt" handouts. Students should answer as many questions as they can while looking at stumps or beaver cookies. If they don't know an answer, challenge them to make a hypothesis. Remind them to respect the stump or tree slice and leave it as they found it. Do not use the pointed end of your pencil to count the rings or poke at the wood. Thank you!

Assessment Ideas

1. Is the oldest part of a tree is the middle or around the outer edge?
2. Draw a picture of cross section of a tree stump including some of the growth rings. Label the springwood and summerwood. Which is the widest? Why?
3. Name some factors that affect the growth rate of a tree.
4. What else can you learn about a tree by looking at its stump? List as many things as you can.
5. In a tropical climate the growing season lasts all year long. What do the growth rings look like on trees that live there? (there are no rings, just solid wood)

References

Vinal, W. *Nature Recreation*.

Leopold Education Project. *Lessons in a Land Ethic.*

National Wildlife Federation. *Ranger Rick's Nature Scope.*

Parts of a Tree

When you see a tree stump in a forest, have you ever wondered what happened to the tree? Is the rest of the tree lying nearby on the ground? Did the wind blow the tree down? Did someone cut the tree? When was the tree cut? Was the tree diseased? What caused it to die? By careful examination and a little background information about trees, you can become a "dendrochronologist," a person who studies the past by looking at tree rings.

The outside of a stump is covered by bark and is usually two different shades of color. The darker colored outer bark is scaly and provides protection for the tree. The inner bark is the living part of the tree in which water and nutrients are transported throughout the tree.

The darker wood in the center of an old stump is called "heartwood" and helps support the tree. The lighter colored wood around the heartwood is the "sapwood," which carries water and nutrients up the tree from the roots to the leaves. In the center of the trunk is the small "pith," which is a food and water storage area.

If you look at a cross section of some tree trunks, you can see a distinct pattern of growth rings. Each ring is a layer of wood produced during one growing season. As a tree begins growing in spring, the cambium produces a light-colored band of thin-walled, large cells called "springwood." As growth slows down in the summer, a darker ring of thick-walled, smaller cells called "summerwood" is formed. Together the springwood and summerwood create an annual growth ring. In most trees growing in temperate and northern climates, one growth ring is formed each year.

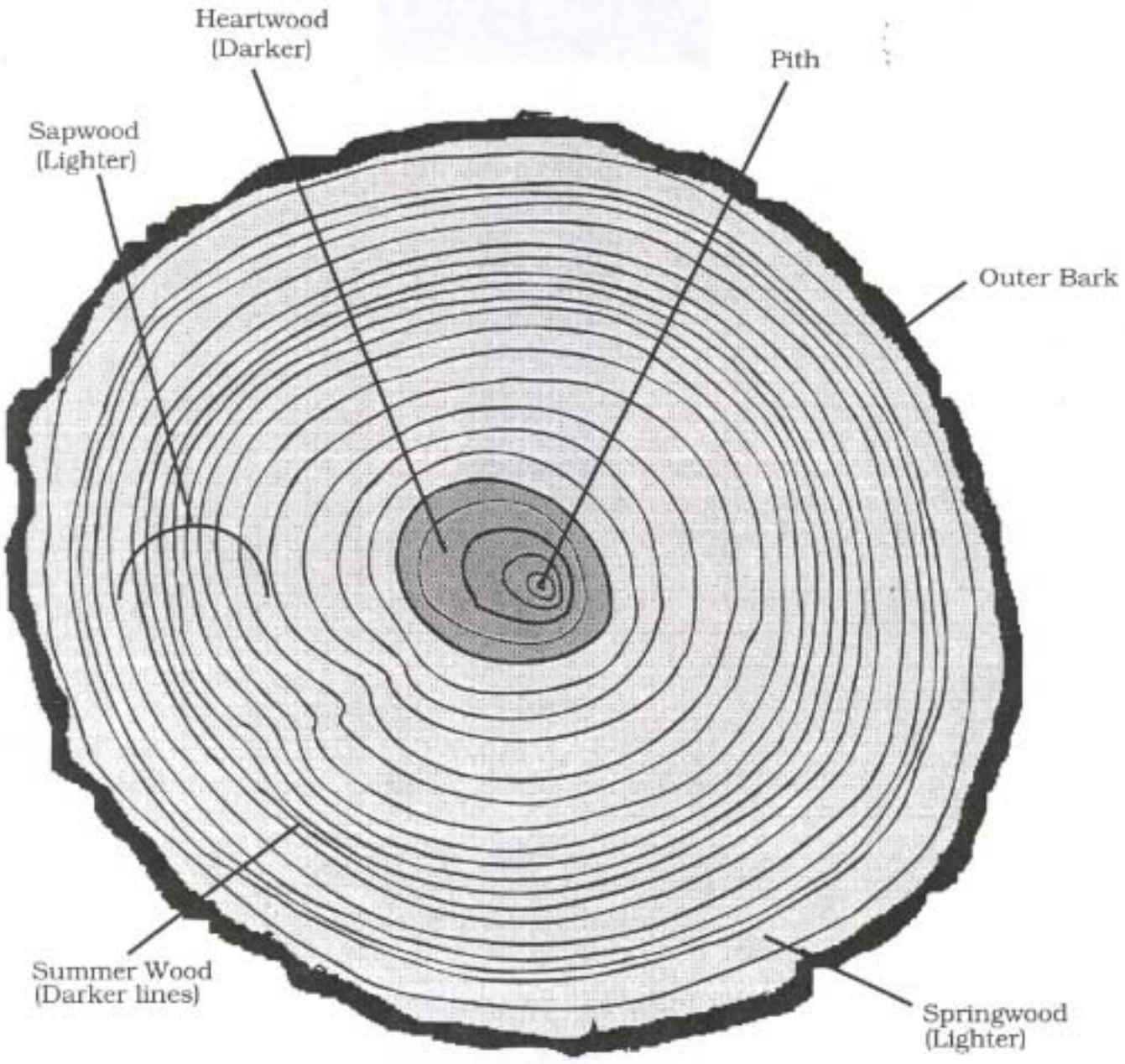
The thickness and appearance of a tree's annual growth rings vary from year to year, depending on growing conditions. During a good growing season, a wide ring is formed. But during a poor growing season (drought, a long cold winter, a spring frost or something else that slows growth), the ring will be much narrower, indicating the tree did not grow very much.

Other factors besides the weather can influence a tree's growth, including insect damage, diseases (viruses, bacteria, fungi), fire, root damage, transplanting, and competition from other trees for sunlight, space, water or nutrients. Many things that cause a tree to be "stressed" will eventually show up in its growth ring pattern. If this stress occurs after the growing season, a narrow growth ring will probably be formed in the next year's growth.

Vocabulary

tree cookie—a round slice from the trunk of a tree showing the annual growth rings
heartwood—darker colored wood in the center of a tree
sapwood—lighter, more porous, younger wood
pith—center of the tree where food and water are stored
springwood—the wider and lighter colored part of an annual growth ring
summerwood—the narrower and darker colored part of an annual growth ring
cambium—area where annual ring is formed each year between the wood and the bark
lichen—a plant made of a combination of algae and fungus
drought—an extended period of time without rainfall

Cross Section of a Tree



Stump Hunt

What kind of tree was this?

How many years was this tree alive?

What did it come from? (a seed, cone, acorn, etc.)

What caused its death?

About how long has it been dead?

Is the rest of the tree nearby?

How much did it increase in diameter per year when it was young?

At what time of the year did it grow most rapidly?

Was it cut before or after its death?

When was it cut?

What tool(s) were used?

Where did the person or team stand when they cut the tree?

In what direction did it fall?

During what season was it cut?

Was it cut during a strong wind, a gentle breeze or a calm period?

Was it cut by an amateur or a professional wood cutter?

Did the tree ever experience drought?

Was it ever burned? If so, how many times?

In what direction was the wind blowing when it was burned?

Which year(s) did the tree grow the most?

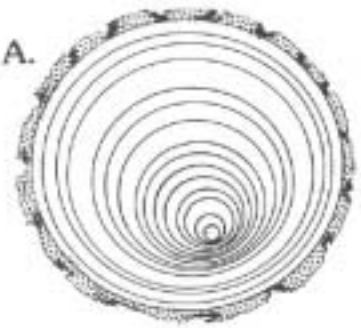
What flowering plants are growing out of the stump?

How many kinds of lichens and mosses can you find growing on the stump?

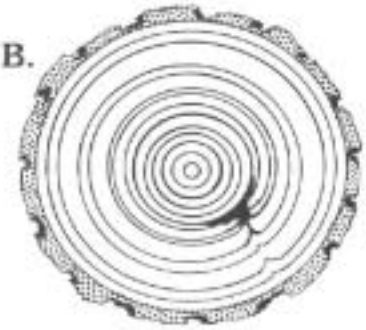
Are there insects living in the stump? How do you know?

Reading the Rings

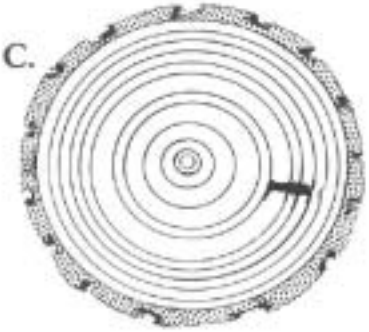
A.



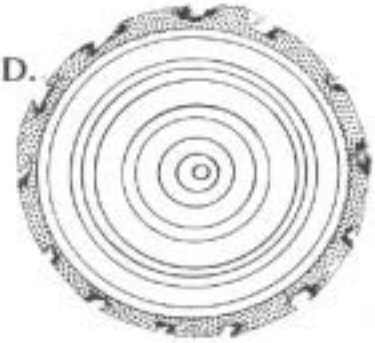
B.



C.



D.



1. Fallen tree _____

2. Fire _____

3. Drought _____

4. Insect attack _____

5. Construction _____

6. Growing on slope _____

7. Dead branch _____

Rotten Logs Help Everyone!

Overview
Students will see how fallen trees and tree stumps are alive with insects, animals, and bacteria. They will see how rotting trees provide habitats and food while returning nutrients to the soil.

Duration
20 min

Grades
K-2

Benchmarks
- Organism
- Diversity/Interdependence
- Collecting & presenting data
- Analyzing & interpreting results

Key Concepts
Dead trees provide an abundance of resources for a variety of living things, including animals, fungi, and other plants.

Objectives
Students will be able to:
- inspect a fallen tree and find signs of insects and animals
- discuss and compare their observations with each other
- draw their observations in their journal

Materials
- journals or drawing paper
- clipboards
- pencils
- hand lenses

Background Information

When a tree dies it rots slowly. Insects bore holes into the trees, building nests so they can live in the trees. Birds love to feed on the insects in dead trees. Some birds like woodpeckers bore larger holes to live in the trees. Often when the birds move out, other animals like squirrels and raccoons move into the holes. The trees provide a habitat for many insects and animals. The wood becomes soft and eventually the tree will fall down. As trees continue to decay they provide habitats and food for animals, insects and bacteria. Finally, when a tree decays completely, it provides nutrients that go into the soil to help make other trees and plants grow healthy.

Suggested Procedure

1. Discuss with students what they see around them in the forest. Point out the various trees, bushes, groundcover, rocks, etc. Ask students what they think happens to all the trees and bushes once they die. Have students look for signs of dead trees around them.
2. Find a fallen tree or tree stump. Have students gather near the rotting tree or stump in small groups. Ask each group to look for signs of insects or animals in the log. Use hand lenses for a closer look. Remind students to be very careful in touching the log so that they don't disturb animal or insect homes. Tell them that the log will be soft as it decays and will crumble easily. Remind students to not put their fingers into the holes they may find, as they may still be homes for animals or insects.
3. In the discussion of what students are observing, ask the following questions:
   - What evidence of insects do you see? Do you see any holes in the wood or patterns on the bark? Do you see anything moving?
   - What condition is the tree in? Do you see leaves? Do you see bark? Does it feel hard or soft?
   - Look under and around the fallen tree. Do you see any plants growing? Are any plants growing on the tree? How do you think a plant could get started on the tree?
   - Do you see any evidence of animals? Are there any holes bored in the wood? Do you see any animals nearby?
   - Why do you think this tree died? How long do you think it has been lying on the forest floor? Why?
   - What happens to the tree when it all crumbles into the soil?
   - Where do you think it goes?

4. Once students have finished examining the log or stump, have them draw their observations in their journals. Give several opportunities for students to look again at the log from a different perspective. Remind students to look closely at the tree or stump but to not break anything off.

Assessment Ideas

Give time for students to share and talk about their drawings. Remind students to add the forest around the tree in their drawings to make a complete picture. Discuss with students evidence that they found of insects or animals that they did not directly observe.

References

Brenner, B. & Leonard, T. *One Small Place in a Tree.*

Green, J. *A Dead Log*.

Hunter, A. *What's Under a Log*.

Project Learning Tree

Kittinger, J.S. *Dead Log Alive!*

Dead or Alive?

Overview
Students will take a close up look at dead trees in a forest and identify many of the organisms that use the wood as a home or food source.

Duration
30 min

Grades
5-8

Benchmarks
- Diversity/interdependence
- Collecting & presenting data
- Analyzing & interpreting results

Key Concepts
Dead wood is not really "dead." It provides many different life forms with the means to survive.

Objectives
Students will be able to:
- understand the role and importance of dead wood in a forest ecosystem
- make discoveries and predictions using detailed observations and drawings

Materials
- journals or paper
- hand lenses
- pencils
- clipboards

Background Information

Dead trees in a forest can often go unnoticed or may seem to "clutter" the forest floor, but a closer look will reveal that the wood is actually full of living organisms.

Once a tree dies, it slowly begins to decay with the help of decomposers. Insects bore holes into the wood, building nests and eating the wood as food. Birds eat some of the insects that live in dead trees. Some birds like woodpeckers bore larger holes so that they can live in the trees. Larger mammals such as squirrels and raccoons live and hide in dead trees too.

Eventually the wood becomes soft and the tree falls down. These downed trees are called "nurse logs" because they provide a habitat for many organisms. Nurse logs provide nutrients that nourish the soil and help other trees and plants grow. Often times moss, ferns and small trees grow on top of nurse logs, which camouflage the log among other forest plants. Usually the older the log is, the harder it is to see.

Suggested Procedure

1. Brainstorm answers to the following questions with students.

   What is a "nurse log"? Is this a good name for dead trees lying in the forest? Why? How do nurse logs benefit a forest ecosystem?

2. Review definitions of vocabulary words.

3. Make copies of the "Dead or Alive?—Observation Sheet" and distribute to students before going outside. Have students briefly read through questions to verify their understanding.

Assessment Ideas

1. Ask students to share their answers to questions #8 and #9 with a partner; then discuss with the class.

2. Make a specific list of all the benefits of dead wood in a forest entitled, "Dead Wood is Good."

Name_____

Dead or Alive?—Observation Sheet

1. Why do you think this tree died?

2. How long do you think this tree has been lying on the forest floor? Why?

3. What evidence of insects do you see?

4. How do you think that plants got started growing on the nurse log?

5. Name the producers, consumers and decomposers you can see.

Producer	**Consumer**	**Decomposer**

6. Draw a food web that includes all the organisms you found.

7. Make a detailed drawing of the nurse log <u>on the back of this paper</u> and label the organisms that you observed.

8. Is a tree more "alive" when it's growing or after it dies? Explain.

9. How would this ecosystem change if all the dead trees were removed?